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ABSTRACT

Three aspects of educational research have hindered a truly scientific approach--artificially simple laboratory settings, a reliance on post hoc computer analysis, and the rule of the contract office. A more scientific setting might be created if three requirements are satisfied: (1) research should be carried out in life situations; (2) focus should be on sets of forces or systems; (3) strategy for choosing topics should be to contrast systems. With these satisfied, one would be studying the ecology of a phenomenon. Twenty propositions define the properties of ecological systems investigation: the experiment has (1) ecological validity and (2) integrity; (3) has contextual validity; (4) allows participant definition of the situation; (5) requires attention to the setting; (6) allows reciprocal processes; (7) recognizes that social systems operate in the research setting; (8) analyzes second order (N+2) and (9) third order (N+3) effects; (10) accommodates temporal and spatial arrangements; (11) conceptualizes and analyzes in systems terms; (12) analyzes interactions between settings; (13) allows cross-set influences in single person experiments; (14) accounts for reciprocal interactions in multi-setting experiments; (15) replicates at the level of settings; (16) examines larger contexts that affect events within the setting; (17) examines developmental transitions from (18) a lifetime perspective, with (19) possible introduction of innovations; and (20) restructures prevailing systems by redefining goals, roles, and activities, and by providing interconnections between systems. Extensive reference list. (MB)

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The Experimental Ecology of Education[1]

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This is a presumptuous paper. It makes bold to call into question prevailing approaches to educational research, and to propose a new perspective in method, theory, and substance concern. I shall refer to this new perspective as the experimental ecology of education.

I. The Ecology of Educational Research

But before examining the ecology of education, I shall discuss briefly the ecology of educational research. Just as the behavior of the learners in our investigations is delimited and directed by the environments in which they live, so is our behavior as investigators shaped and, as I shall endeavor to show, presently stunted by our professional milieu. Specifically, I shall argue that forces emanating from three settings in the contemporary world of educational research have diverted us from the true course of scientific advance. These settings are the laboratory, the computing center, and, especially, the research contract office. All three have generated lines of force that function as magnetic fields holding us fast and retarding forward movement. In particular, the forces have inhibited the processes most essential to research progress--systematic observation, thought, and scientific imagination.

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[1]This paper was prepared for presentation as the AERA Award Address at the 1976 Annual Meeting of the American Educational Research Association, San Francisco, California, April 19-23, 1976. The ideas set forth in this paper grow out of work carried out by the author as a Belding Fellow of the Foundation for Child Development. Appreciation is expressed to the Foundation and its staff, in particular Orville G. Brim and Heidi Sigal.

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These are strong charges and deserve some justification. To consider first the setting that is usually regarded as the primary and proper source of basic knowledge in our field, knowledge about human learning, motivation, and development. I refer, of course, to the psychological laboratory. As I have argued elsewhere (Bronfenbrenner, 1973a, 1973b, 1974a, 1975a, 1975c), classical laboratory experiments, and their contemporary derivatives, have almost invariably involved situations that are unfamiliar, artificial, short-lived, and call for unusual behaviors that are difficult to generalize to the real world. From this perspective, it can be said that much of developmental psychology is the science of the strange behavior of children in strange situations with strange adults for the briefest possible periods of time.

Partially in reaction to such shortcomings, other workers in the field have stressed the need for social relevance in research, but often with indifference to or open rejection of scientific rigor. In its more extreme manifestations, this trend has taken the form of excluding the scientist himself from the research process. For example, one major foundation has recently stated as its new policy that, henceforth, grants for research will be awarded only to persons who are themselves the victims of social injustice. Other, less radical expressions of this trend involve reliance on existential approaches, in which "experience" takes the place of observation, and analysis is foregone in favor of a more personalized and direct "understanding" gained through intimate involvement in the field situation. More common, and scientifically defensible, is an emphasis on naturalistic observation, but with the stipulation that it be unguided by any hypotheses formulated in advance, and

uncontaminated by structured experimental designs imposed prior to data collection.

In moving from the laboratory into the field, most educational researchers, however, have not gone so far. We continue to honor the traditional imperatives of the experimentalist--an insistence on explicit hypothesis formulation, and on scientific rigor. Yet, the operational definition of these requirements is no longer the same. All too often, the hypothesis, rather than constituting a statement of tentative explanation as called for by the philosophy of science, is simply a statistical prediction: "Group A will have a higher score than Group B, such and such variables held constant." Or, in more sophisticated designs: "The path coefficients will indicate that most of the variance is accounted for by Variables X_i, X_j, and X_k in that order, where X_i's are school characteristics, X_j's family background factors, and X_k's protest scores." The results, of course, turn out in the reverse rank order, with the path coefficients for schools approaching zero in magnitude.

I shall revert to this last, and often recurring, phenomenon at a later point to argue that it reflects not the ineffectiveness of our schools but the inadequacy of our research models. It is this latter thesis that I now wish to pursue. To recapitulate, whereas contemporary educational research pays homage to hypothesis formulation and scientific rigor, it does so in ways that are rather different from those employed in the laboratory. To give the latter setting its due, although psychological experiments may be artificial and ephemeral, they typically do

embody a basic principle of scientific method: they are deliberately and systematically designed to enable the investigator to observe events that allow for mutually exclusive inferences about ongoing psychological processes. In contrast, much educational research is preoccupied merely with assessing outcomes and identifying which factors are statistically associated with these outcomes; underlying processes, to the extent that they are considered at all, become matters for speculation based on the pattern of statistical associations. Moreover, such patterns are almost invariably susceptible to multiple and equivocal interpretations, since unlike the laboratory experiment, the typical field research is not designed in such a way as to permit ruling out alternative explanations at the level of causal mechanisms.

Paradoxically, this equivocal state of affairs obtains even when the research takes the form of a contrived educational experiment with subjects assigned to treatments at random, for these treatments are usually programs that, because they reflect the variability in current practice, differ from each other in a myriad, theoreically unrelated ways, including objectives, staffing, schedule, social structure, and, of course, curriculum. The usual defense against such criticism is that educational research deals with the real world and must therefore cope with all its complexities. I accept the scientific challenge but reject the strategy so often employed for its implementation on the ground that it is not scientific: it simply takes the world as it comes, and makes no attempt

to select, let alone to construct, systematic contrasts that could expose the crucial structures and events that motivate and sustain the persons and processes involved in an educational experience.

To state the thesis in its briefest and boldest form, contemporary educational researches are characterized by experimental designs that are primarily statistical rather than scientific: that is, these designs enable us to predict the concomitants of certain combinations of conditions, but not to understand the causal connections that produce the observed effects. Thus we know that educational achievement, at least as measured by standardized tests, varies as a function of such factors as social class or, more recently and specifically, family size (Zajonc, 1976), but we do not know how, or often even whether, the income, education, or occupation of the parents, or the number or spacing of their children, functions to enhance or impede a child's learning in school.

Moreover, I submit that the reasons for our ignorance lie not in our personal limitations as researchers, but in the shortcomings of the designs that we employ, and that these shortcomings, in turn, are being forced upon us by the settings in which we work. Here, for example, it is not the laboratory that restricts our vision, but the computing center that inhibits thought by creating the seductive illusion of seeming to do our thinking for us. We no longer have to worry about which are the most important factors to include in the design: the computer can take them all. Nor do we have to be so concerned about matching, balanced designs, proportional frequencies, or even insuring at least one entry

in every cell. Now that canned programs can handle unequal numbers, including zero, we don't have to construct our experimental designs in advance; we can wait until all the data are in and then ask whatever questions we want afterwards.

This new found freedom is all made possible by a great discovery achieved by our methodologists. We no longer need to master those complicated Fisherian designs with their replications, nested effects, and different error terms, let alone Greek and Latin squares. Analysis of variance and covariance have been shown to be algebraic equivalents for something we understand much better--multivariate analysis, which is closely related to an old friend, multiple and partial correlation. The translation from Fisherian to Pearsonian terms is accomplished by a device which, from the perspective of my argument, could not have been more aptly named--"using dummy variables." You don't have to think about them, just plug them in as zeros or ones in the regression equation. The term regression is also ironically appropriate, for the strategy, as it is usually applied, is indeed a backward one, foregoing prior observation, thinking, and experimental design in favor of post hoc analysis.

But it is not only the seductive capacity of computers that propels us toward mindlessness in educational research, or what we used more charitably to call "dustbowl empiricism." Other, more remote settings pull us even more powerfully in the same direction. I refer to research contract offices both at the Federal and, more recently, at the State level. It is one thing to argue, as I have elsewhere (Bronfenbrenner,

1974a, 1974b), that our science needs to address social policy issues if we are to make significant progress in the development of basic theory, method, and knowledge in our field. It is quite another to allow policymakers, or their overburdened assistants, to decide what specific research we shall do in order to answer the questions they view as most relevant to the administrative decisions confronting them on a day-to-day basis. As one more manifestation of the anti-intellectualism and anti-humanism that pervades our nation and its leadership as we enter our third century, there has been a major shift in recent years away from research grants to investigate social problems formulated, at least in part, by social scientists, to research contracts obligating the investigator to answer only specific questions narrowly defined, primarily in an administrative context, by non-scientists.

The danger in asking the wrong question is that it almost inevitably leads to a wrong answer, whether from a scientific or social policy perspective. For this reason, we as researchers have an obligation, both to our science and our society, to refuse funds for research on irrelevant questions that bypass the significant problems we so desperately need to solve. This is easier to say than do, for it requires us to resist temptation and risk ending up in the most embarrassing position for a researcher in today's research establishment--stark naked without a grant to his name.

But that is not the only reason we cannot stop with refusal. As researchers, we also have a responsibility to identify and seek recognition for the important problems that do need to be addressed, and to indicate the scientific strategies required for their solution.

II. A Reorientation

This brings me to the second and more difficult task I have undertaken in this paper. I have now fulfilled the first and least important part of my pretentious promise. I have invoked a plague not merely on both but on all three houses of our science. Paradoxically, having denounced them equally, I now propose to do them equal honor by seeking to bring them together in what I hope is today a more congenial climate in the research community than the one of divided families that has prevailed in the recent past. Specifically, I shall propose first an expansion, then a convergence, and finally a conversion--not religious but theoretical--to a new, unified scientific view that incorporates both field and experimental approaches. More precisely, I offer for your consideration a theoretical model to replace the restricted conception of the environment implicit in our current research approaches. I refer to this broadened scientific perspective as the experimental ecology of education.

Basic Requirements of Ecological Research

I shall begin by stating three basic requirements that, in my judgment, must be met if we are to make progress in the scientific study of educational systems and processes.

1. Our researches cannot be restricted to the laboratory; for the most part, they must be carried out in real-life educational settings. As will be indicated below, this does not mean that laboratory experiments cannot serve a useful and, indeed, essential purpose, but they must be

carried out with explicit recognition of the delimiting and distorting nature of the laboratory as a setting and deliberately designed to articulate closely with and complement companion researches carried out in real-life situations.

2. Whether and how people learn in educational settings is a function of sets of forces, or systems, at two levels;

a. The first comprises the relations between the characteristics of the learner and his or her surround in each of the principal environments in which he lives out his life (e.g., home, school, peer group, work place, neighborhood, community).

b. The second encompasses the relations and interconnections that exist between these environments.

The scientific study of both sets of relations as they affect learning constitutes the ecology of education and represents a major and necessary focus for educational research.

3. The strategy of choice for investigating person-environment and environment-environment relations is the ecological experiment, defined as a systematic contrast between two or more environmental systems, or their structural components, with a careful attempt to control for possibly confounding influences, either by random assignment or by matching on subject characteristics or other relevant factors.

Henceforth, I shall refer to the former as a contrived experiment, and the latter as an experiment of nature or natural experiment. I deliberately eschew the term typically employed in the literature of

statistical design--"quasi-experiment," because it suggests a lower level of methodological rigor, an implication I regard as unwarranted on strictly scientific grounds. As I shall endeavor to show, there are many instances in which a design exploiting an experiment of nature provides a more critical contrast, insures greater objectivity, permits more precise and theoretically significant inferences--in short, is more elegant and constitutes "harder" science than the best possible contrived experiment addressed to the same research question.

Our ecological perspective, however, highlights a possible error in research design to which the naturalistic experiment is especially vulnerable; namely, in the process of introducing controls, the investigator may not only seriously restrict the generalizability of findings to similarly constrained samples and settings but may in fact produce a situation so artificial as to call into question its ecological validity (see page 17ff below).

The foregoing formulations have several important implications that need to be made explicit.

First, we note that, in contrast to most educational research, the ecology of education is not and cannot be confined to investigations in strictly educational settings. Indeed, the second principle implies that what happens, or fails to happen, in an educational setting depends in large part on events and relationships in other spheres of the person's life.

Second, in contrast to most educational research, the ecology of education is not and cannot be confined solely to conditions and events

occurring within a single setting, such as home, school, peer group, work place, etc.; equal emphasis must be given to relations obtaining between settings.

Third, to the extent that educational research currently deals with person-environment and environment-environment relations, these are usually described by means of an array of variables that are treated as separable from one another, linear, and additive. In contrast, an ecological model calls for the conceptualization of environments and relationships in terms of systems. What does this imply?

The main body of this paper represents, in effect, an extended answer to the last question. As a first step in the process, I offer the following working definition of the ecological environment. The structure of this environment, and its systems properties, will be further differentiated in subsequent sections.

The Ecological Structure of the Educational Environment

The environment is conceived topologically as a nested arrangement of structures, each contained within the next. For the purpose of describing these successive levels, we shall employ a terminology adapted from Brim (1975).

1) A micro-system is an immediate setting containing the learner (e.g., home, day care center, classroom, etc.). A setting is defined as a place in which the occupants engage in particular activities in particular roles (e.g., parent, teacher, pupil, etc.) for particular periods of time. The factors of place,

time, activity, and role constitute the elements of a setting.

2) The meso-system comprises the interrelations among the major settings containing the learner at a particular point in his or her life. Thus, for an American elementary school child, the meso-system typically encompasses interactions among family, school, peer group, television; for some children, it might include as well church, camp, or work place, although the last would be less common in the United States than in some other societies. In sum, stated succinctly, the meso-system is the system of micro-systems.

3) The exo-system is an extension of the meso-system embracing the concrete social structures, both formal and informal, that impinge upon or encompass the immediate settings containing the learner and, thereby, influence and even determine or delimit what goes on there. These structures include the major institutions of the society, both deliberately structured and spontaneously evolving, as they operate at the local community level. These encompass, among others, the world of work, the neighborhood, mass media, agencies of government (local, state, and national), the distribution of goods and services, communication and transportation facilities, and informal social networks.

4) Macro-systems are the overarching institutions of the culture or subculture, such as the economic, social, educational, legal, and political systems, of which local micro-, meso-, and exo-systems are the concrete manifestations. Such macro-systems are conceived and examined not only in structural terms but as carriers of inrormation and ideology that, both explicitly and implicitly, endow meaning and motivation to particular

> agencies, social networks, roles, activities, and their interrelations. Whether children, parents, pupils, teachers, or other persons directly involved in the learning process have any place or priority in these macro-systems is of especial importance in determining how such persons are treated and interact with each other in different types of educational settings.

Especially in its formal properties, the foregoing conception of the environment, as well as the dynamic relation between person and situation implied in our definition of the ecology of education, draws heavily on the theories of Kurt Lewin (1935, 1936, 1948, 1951). Indeed, this effort may be viewed as an attempt to provide psychological and sociological substance to Lewin's brilliantly conceived topological territories.

The Experiment as a Heuristic Strategy

Having considered the implications of our second basic requirement, regarding the scope and structure of the ecological environment, we turn to the third and final core principle, which designated the ecological experiment as the strategy of choice for research in education. There is an unorthodox implication in this assertion that is likely to be challenged when made explicit. We are accustomed to thinking of the experiment as the final step in the research process. Yet, the principle as stated would seem to define the experiment as a preferred strategy at all stages of investigation right from the beginning. This is indeed the intent. I do advocate that experiments be employed in the very first phases of scientific inquiry. But not for the usual objective of testing hypotheses

(although this device is used as a means to an end). In ecological research, the early use of the experiment becomes desirable for heuristic purposes; namely, to analyze systematically the nature of the relation that exists between the learner and the surrounding milieu. That relation is not an easy phenomenon to recognize. It falls within the purvey of those events of which Goethe wrote with his poet's prescience: "Was ist das Schwerste von allem? Was dir das Leichtests dunket, mit den Augen zu sehen, was vor den Augen dir liegt." (What is the most difficult of all? That which seems to you the easiest, to see with one's eyes what is lying before them.) We shall shortly encounter some concrete examples of this perceptual problem as it arises in educational research.

If looking is not enough, what is one to do? How can the observer quicken his sensitivity to the critical features of the observed? The answer to this question was given me a quarter of a century ago, long before I was ready to appreciate it, by my first mentor in graduate school, Walter Fenno Dearborn of the Harvard Graduate School of Education. In his quiet, crisp New England accent, he once remarked: "Bronfenbrenner, if you want to understand something, try to change it." And whether one studies change by deliberately altering conditions in a contrived experiment or by systematically exploiting an "experiment of nature," the methodological objective is the same: to maximize one's sensitivity to phenomena through the juxtaposition of contrasts. As with a vernier, it is only when two similar but different systems are put side by side, that one can begin to see clearly the nature of the differences between

them. The systematic juxtaposition of the similar but different constitutes the core of the experimental method and creates its magnifying power.

But the strategy of experimentation has an even more important asset that makes its early application critical for research in the ecology of education. To adapt Dearborn's dictum to this domain: If you wish to understand the relation between the learner and some aspect of his environment, try to budge the one, and see what happens to the other. Implicit in this injunction is the recognition that the relation between person and environment has the properties of a system with a momentum of its own; the only way to discover the nature of this inertia, and its interdependencies, is to try to disturb the existing balance.

It is from this perspective that the primary purpose of the ecological experiment becomes not hypothesis-testing but discovery--the identification of those systems-properties and processes that affect, and are affected by, the behavior and development of the learner. Since the environment as here conceived encompasses both immediate and larger social contexts, the experimental design cannot be simplistic; it is necessarily complex. And, in keeping with its heuristic function, it must fulfill more than the usual and essential requirement of controlling for possibly confounding factors. It must perform the more scientifically fruitful task of providing a highly differentiated and thereby sensitive grid that make possible more precise detection of differences and changes in the state and structure of ecological systems.

This brings us to yet another and perhaps most important feature of the ecological experiment that distinguishes it from the laboratory

prototype: The difference lies not only in the requirement of a real-life setting, but in the nature of the underlying research model. In the classical psychological experiment, antecedent and consequent conditions are couched in terms of variables that are conceived as linear, additive, and distinct from each other. In an ecological model, status and change are viewed not solely in terms of different levels of one or more separate variables, but also, and primarily, as differences in systems or system states. To understand what is meant by these constructs, we must undertake an analysis of the properties of systems involving the relation between learner and environment. These properties, in turn, must then be incorporated in the research models we employ for investigating the ecology of education.

We shall pursue these tasks of theory and method by examining the properties of ecological systems at each of the four hierarchical levels of the environment delineated in our conceptual model; namely, the micro-, meso-, exo-, and macro-systems. At every level, the defining properties of the system will be presented in a series of propositions, each accompanied by one or more examples of concrete investigations--actual when available, hypothetical when not--to illustrate the given proposition, either by demonstration or default.

The reference to hypothetical examples and demonstration by default reflects the fact that, for reasons already indicated, well-designed, ecologically valid experiments are, as yet, not easy to find. In an effort to alter this state of affairs, the author was fortunate in enlisting the support of the Foundation for Child Development in initiating

a small-scale program of research grants and career development awards in the ecology or human development. The aim or the program is to encourage scientific work and training in the systematic study of "the behavior and development of children, and those who care for them, in the enduring environments in which they live." A number of ecological experiments cited below were supported by grants from the FCD program.[2]

We turn, then, to a systematic analysis of the properties of ecological systems at four successive levels of complexity.

III. The Micro-system: Properties of the Immediate Setting

Real-life vs. Laboratory

We begin this section with a disclaimer. In the analysis that follows, and indeed throughout the paper as a whole, we emphasize the importance of conducting rigorous experiments in naturalistic environments, of attending to the major dimensions of the real-life setting, and of recognizing the limitations of ignoring either reality or rigor in educational research. This emphasis should not be interpreted, however, as an argument against the use of other scientific strategies, including laboratory experiments. On the contrary, we shall argue that laboratory experiments can play a constructive, critical role, provided certain conditions are met. The nature of these conditions is determined by the characteristics that distinguish the laboratory setting from a real-life situation. The first set of propositions we present deal with these distinctive properties.

Ecological validity. We begin with a statement that is axiomatic for ecological research.

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[2]Further information may be obtained by writing to: Joyce Brainard, Administrative Aide, Program on the Ecology of Human Development, Department of Human Development and Family Studies, Cornell University, Ithaca, New York 14853.

> Proposition 1. An experiment is ecologically valid when it is conducted in settings that occur in the culture or subculture for other than research purposes, or might occur if social policies or practices were altered. The requirement of ecological validity applies to all the elements of the setting; that is, place, time, roles, and activities.

The foregoing proposition is violated, for example, whenever research subjects are placed in a setting, or asked to engage in a task, that is alien to the socioeconomic, ethnic, or social milieu from which they come, a point we shall return to later. The experiment must also last long enough to approximate what happens in real life. Finally, the roles and activities in which the subjects are engaged should be appropriate to the situation and have established social meaning for the participants. From this point of view, it is noteworthy that the only condition for which the laboratory turns out to be an ecologically valid setting is for studying the behavior and development of researchers in their native habitat.

Preserving the integrity of the setting. But what about the possibility of bringing into the laboratory people and pieces from the outside world, or reasonable facsimiles thereof--so-called simulation experiments? Is not this a viable road to reality? In the last analysis, this is an empirical question and some data are becoming available on the issue. In general, the results indicate that the strangeness and ambiguity of the laboratory situation tend to increase negative feeling states and decrease manifestations of competence and consideration for others.

For example, Ross et al. (1975) found that the infant's distress upon being left alone with a stranger was substantially greater in the laboratory than in the home. The children cried three times as long in the former setting. At a broader social level, Lamb (1975b) has reported that social class differences in father-child interaction studied in the laboratory, disappeared when analogous observations were conducted in the home.[3]

That naturalistic situations are also more likely to evoke constructive activity in adults is indicated in Piliavin, Rodin, and Piliavin's study (1969) of reactions to persons in distress. Noting that much of the research on withholding versus giving help to a victim has been conducted in the laboratory, these investigators carried out a field study of "Good Samaritan" behavior in the New York subway. On the 7½ minute run between 59th and 125th Streets on the West Side, the investigators "staged standard collapses" of a victim who appeared either ill (carrying a cane) or drunk (carrying a bottle). The original purpose of the study, to test the effect of a model in activating helpful behavior, was frustrated by the frequency and rapidity of spontaneous help offered by the passengers. In almost 80% of the trials, someone came to the rescue before the model could act. In the words of the investigators:

> The frequency of help received by the victims was impressive, at least as compared to earlier laboratory

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[3]Lamb's research was supported by a grant from the FCD program on the Ecology of Human Development.

> results.... On the basis of past research, relatively long latencies of spontaneous helping were expected; thus, it was assumed that models would have time to help, and their effects could be assessed. (p. 292)

In short, in a situation of clear need, people turn out to be quite helpful. One is reminded of Harry Stack Sullivan's comment about the importance of the situation even in the behavior of psychotics: "We are all much more simply human than otherwise" (1947, p. 7).

Similarly enhanced effects in a real-life situation were obtained in an ingenious exploitation of an "experiment of nature" by Seaver (1973) on the controversial phenomenon of induced teacher expectancies first reported by Rosenthal and Jacobsen (1968) and referred to by them as "Pygmalion in the Classroom." Seaver's research was motivated by some reservations regarding the ecological validity of methods previously employed for the study or this pehnomenon. In his words:

> Most previous attempts to demonstrate the teacher expectancy effect has used experimental manipulations of teacher expectancies that were artificial and surely unusual in the experience of the teachers. Quite possibly these manipulations were also implausible to the teachers and induced psychological states other than the desired expectancies. (p. 334)

To achieve ecological validity, Seaver examined differences in the academic achievement of elementary school pupils with older siblings who

had had the same teacher and performed either exceptionally well or exceptionally poorly. Children taught by teachers who had not instructed the older siblings served as controls. In contrast to earlier studies, which had produced inconsistent, weak, or questionable effects, the results of Seaver's natural experiment gave substantial support to the teacher expectancy hypothesis.

It is significant that the experimental manipulations criticized by Seaver for their artificiality and ambiguity were carried out not in laboratory studies but in experiments conducted in the field. Here we may note our first example of the narrowing and regressive influence of the laboratory model on research in real-life situations. The carry-over leads both to elimination of elements normally present (e.g., asking a mother to remain expressionless, or to refrain from initiating any social interaction with the child) and to the introduction of extraneous elements (e.g., indicating a choice by pushing buttons on an electronic console). These changes represent, on the one hand, an impoverishment of available cues, and, on the other, a contamination of the familiar context. It is not unreasonable to expect that, in terms of their effect on the participants, these factors combine to increase the ambiguity of the situation, generate feelings of uncertainty, and, thereby, result in an attenuated or, especially in children, a maladaptive response.

The foregoing considerations constitute the basis for our second proposition.

> Proposition 2. In contrast to the common experimental practice of employing only selected aspects of or analogues to the real-life situation (i.e., simulation) or introducing extraneous elements, an ecological experiment entails a determined effort to keep such distortions to a minimum. This is the requirement of preserving the ecological integrity of the setting.

As in all science, the foregoing requirement of course represents an ideal that can never be fully achieved, since the very fact that the setting is being investigated constitutes an intrusion. If a "determined effort is made," however, the intrusion can indeed be kept to a minimum, especially in an experiment of nature, as Seaver's study so effectively demonstrates.

Contextual validity. The caution against placing research subjects in an ecologically ambiguous situation applies not only to the immediate setting, but to the larger context from which the subjects are drawn. Specifically, if the locale into which the subjects are placed, or the roles and activities in which they are asked to engage, do not occur frequently in their own subculture, then, regardless of how common such experiences may be in the society at large, they become ecologically invalid for the group in question. This is of course the basis for the severe criticism (Labov, 1967; Riegel, 1975; Sroufe, 1970; Tulkin, 1972) that has been properly levied against studies of social class and ethnic differences based on standardized psychological tests, not to mention experimental measures of conservation, performance on the prisoner's

dilemma, or other operations borrowed from the laboratory. Particularly when these procedures are administered in university settings, the results may give a misleading picture of how effectively the very same persons may in fact be functioning in their own milieu. This consideration brings us to our third proposition.

> Proposition 3. The criteria for the ecological validity of a research setting for particular research subjects are dictated by the characteristics of the larger social and cultural context from which the subjects are drawn. This is the requirement of contextual validity.

But even in the absence of significant ecological ambiguity or dissonance, the tradition of the laboratory can put blinders on the researcher once he moves out into the world. Two types of omissions are especially noteworthy in this regard.

Phenomenological validity. The first is illustrated in the otherwise exemplary research of Seaver described above. Ironically, this to date most definitive study of teacher expectancy, did not actually investigate teacher expectancy at all; it examined only the presumed effects of such expectancy on the performance of school children. Thus the teachers were never asked any questions that might have shed light on how they viewed their pupils, or whether they held different attitudes or expectations toward youngsters assigned to the experimental vs. the control group.[4] In consequence, as Seaver himself acknowledges, the findings are

[4] Also not examined in Seaver's study was the role of time as an element of the setting. Presumably, the expectancy effect should have been greater when the age interval between sibling pairs was shorter.

possibly confounded. Teacher expectancy may not have been operative at all. Instead, the transmitter of the message to the younger child may have been the older sibling, and perhaps parents as well.

The failure to obtain the participants' views of the experimental situation is typical of research in the area, and represents yet another transfer to the real-life situation of the limited perspective of the laboratory, in this instance, its exclusive focus on objective behavior to the neglect of subjective elements--the perceptions and feelings of the persons serving as subjects in the experiment.

The exclusion of the subjective from the domain of rigorous scientific inquiry in all likelihood had its origins in the desire to eliminate the "personal equation" in early studies in astronomy and physics. The stricture has been seldom challenged in experimental psychology, probably because so much of the work has been done with animals. But once again, a research model that may be reasonably adequate for the study of behavior and development in subhuman species turns out to be insufficient for the human case.

The reason for the insufficiency was recognized earlier by sociologists than psychologists, since, the former, from the very beginnings of their discipline, were more oriented toward studying events in the real world. It was the Chicago school of Cooley (1902), Mead (1934), and, in particular, Thomas (Thomas, 1927; Thomas & Thomas, 1928; Thomas & Znaniecki, 1927) who stressed the importance of the person's subjective view--in Thomas's language the definition of the situation--as a major determinant of action. Perhaps the only sociological proposition that approaches the status of an immutable law is Thomas's inexorable dictum: "If men define situa-

tions as real, they are real in their consequences" (Thomas & Thomas, 1928, p. 572).

In psychology, the role of perceived reality in influencing behavior and development was first emphasized by Lewin in his concept of the "psychological field" (Lewin, 1935; Bronfenbrenner, 1951). The principle was applied to social psychological experiments in a classic paper by MacLeod (1947). Drawing upon the European tradition of phenomenological analysis in the psychology of perception (Katz, 1911, 1930; Koffka, 1935; Köhler, 1929, 1938; Wertheimer, 1911), MacLeod emphasized the need to answer the question: "What is 'there' for the individual.... What is the social structure of the world he is living in?" (p. 204).

Unfortunately, these essentially theoretical analyses had little impact on empirical work, so that experimental studies in education continued to be overwhelmingly behavioristic and, thereby bereft of "meaning." This omission is critical in research on human beings, for, as Mead pointed out (1934, pp. 304-355), it is precisely in our capacity to attribute meaning to stimuli that we differ most from subhuman species. From an ecological perspective, this implies that the impact of the setting cannot be understood without some information on how the setting, and its various elements, were perceived by the participants. Accordingly, we come to our fourth proposition.

> Proposition 4. In contrast to the classical laboratory study, in which the data are typically limited to objective measures of the subject's performance, an ecological experiment cannot be solely behavioristic;

> provision must also be made for assessing each participant's definition of the situation, how he or she perceives the setting and its various elements. This is the requirement of phenomenological analysis.

A number of implications follow from Proposition 4, of which one merits explicit mention as a corollary.

> Corollary 4a. Phenomenological analysis is especially important for the construct validation of experimental manipulations and outcomes; that is, an examination of whether these elements are perceived by the participants in a manner consistent with the conceptual definitions explicit and implicit in the research design. This is the requirement of phenomenological validity.

Subjects in a vacuum. It is not only the subjective world that is excluded from the experimenter's view in the classical laboratory model, some features of objective reality are also ignored. Thus, it is not uncommon, especially when the researcher moves out of the laboratory into the real-life setting, to omit description of the setting itself and the people and activities within it. For example, in many studies of alternative structures for child rearing and education such as day care vs. home care, intact vs. father-absent homes, kibbutz vs. family, experimental teaching programs, and, especially, cross-cultural dif-

ferences in socialization and schooling, data are reported only for outcome measures (e.g., psychological tests) with no information provided about the nature of the setting, the roles, activities, and other elements present, or other environmental features that in fact account for the observed differences or similarities. In all these cases, the main emphasis is on analyzing the differential characteristics of the children, not of the settings in which they are found. As a result, interpretations of environmental effects are often couched in what Lewin (1935) called class-theoretical terms; that is, observed differences in children from one or another setting (e.g., lower class vs. middle class, French vs. American, day care vs. home care) are "explained" simply as attributes of the context in question. And even when the environment is described, it is in terms of a static, self-contained structure of relations and values that makes no allowance for processes of interaction through which the behavior of participants in the system is instigated, sustained, and developed. These deficiencies disclose, by default, the defining core of an ecological approach to education; namely, its focus upon the dynamic relations between the learner and his surround, with both the person and the environment engaged in reciprocal tensions and activities, and undergoing progressive changes over time.

It is only recently that investigators have begun to employ research models that allow not only for assessing the effects upon children of exposure to different kinds of settings but also for analyzing the structure and pattern of activity specific to each setting as these affect and are affected by the developing child. A case in point is the ongoing longitudinal study by Cochran (1975, 1976) of the development of Swedish

children brought up in their own homes, in family day care, and in group care.[5] Before seeking to assess the effect of these settings on the child, Cochran conducted observations and interviews designed to describe the activities taking place in each context, as well as similarities and differences in the nature of social interactions between children and adults, and of children with each other. Results from the first phase of the study include the following:

> Interaction between adults and child were occurring with considerably greater frequency and duration in the homes and day homes than in the centers, thus providing greater opportunity for socialization by significant adults. The interactions which distinguished homes from the centers were cognitive verbal (reading, labeling, face-to-face verbalizing) and exploratory in nature. The exploring in the homes involved a child playing with things not designed to be played with... (Cochran, 1976, p. 5)

In interpreting these results, Cochran rejects psychoanalytic interpretations, stressed by Ainsworth and Bell (1970) and others, in favor of an ecological explanation in terms of

> the different roles performed by adults in the center and family settings.... Caregivers are wives and neighbors as well as mothers at home, and the environment is organized

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[5]Cochran's research has been supported by a grant from the FCD program on the Ecology of Human Development.

> accordingly. Friends and relatives are received in the home. It may be a display area for parents' prized possessions. Plants and flowers are often within reach. The child has access to the dishwashing detergent, the back stairs and the cat. Opportunities for exploration are more numerous in the homes, therefore, than in the centers, where the single role of the adult is child care and the setting is single purpose in design. (Cochran, 1975, p. 3)

The tendency to pay attention only to the learner and to neglect the characteristics of the setting is, of course, yet another carry-over from conventional laboratory research with its exclusive focus on the experimental subject. An ecological perspective, however, with its concern for the mutual accommodation between the learner and his or her surround requires consideration of all the participants in the setting. Hence, we arrive at Proposition 5.

> Proposition 5. In contrast to the conventional research model, in which scientific attention is focused primarily on the behavior of certain persons, all engaged in the same role and designated as the experimental subjects, an ecological experiment requires equal attention to the properties of the setting, in terms of both its physical and its social structure, and to the relations that obtain between the properties of the setting and the behavior manifested by the participants. This is the requirement of setting analysis.

The consequences of omission versus inclusion of critical aspects and occupants of the setting will be illustrated in additional studies described below.

The role of laboratory experiments in educational research. Having examined the properties that distinguish the laboratory situation, and its derivatives, from naturalistic settings, we are now in a position to indicate the conditions under which the former approach can make a valuable contribution to research on the ecology of education. There are three major prerequisites that emerge from the preceding discussion:

1) Laboratory experiments both in their design and execution, must be combined and closely articulated with parallel researches in real-life settings.
2) The results of laboratory experiments must be interpreted with due regard to the limitations and possible distortions revealed by the foregoing analysis.
3) Laboratory studies have the advantage of being more readily amenable to rigorous experimental control. Their reduced ecological validity, however, seriously limits the generalizability of results to real-life settings. Accordingly, in educational research, their primary scientific value is for the exploration and clarification of hypotheses, not for definitive testing.

Analysis of the Setting as a System

Even when educational research is conducted in a real-life setting, and all of the critical elements are taken into account, the requirements of an ecological model are not yet met so long as these elements are examined only one at a time. The concern with mutual accommodation between

learner and environment implies consideration of the various factors, including the behavior of the different participants, simultaneously as members of a system. The next set of propositions deals with these systems-properties as they apply to the immediate setting containing the learner.

Reciprocity. It is a sign of some progress that the first systems-property to which we call attention is one that many readers will recognize and applaud. In the classical psychological research model, whether in the laboratory or in the field, there were, and often still are, only two parties--an experimenter, identified solely, and apparently still acceptably, as E; and, another person equally informatively described as S--the subject. The term subject is apt, for it reflects the fact that, with few exceptions, the process operating between E and S has been viewed as unidirectional; the experimenter presents the stimulus, and the subject gives the response. Nowadays, we all know that the process goes both ways. In more formal terms:

> Proposition 6. In contrast to the conventional, unidirectional model typically employed in the laboratory, an ecological experiment must allow for reciprocal processes; that is, not only the effect of A on B, but also the effect of B on A. This is the requirement of reciprocity.

The principle of reciprocity has special significance when applied to educational research. It means, for example, that we should look not only for the influence of the parent on the development of the child,

but also for the effect of the child on the development of the parent. One suspects that among the most significant psychological changes that take place in adulthood are those that occur as a function of the behavior and development of our children. Here, then, is our first new domain unlocked by the ecological key--not very big, to be sure, perhaps no larger than the upstairs bedroom, but, as we all know, a lot can go on there.

While the thesis that most behavior in social situations is reciprocal is generally accepted in principle, it is often disregarded in practice. As a case in point, we may examine a series of ingenious ecological experiments and follow-up studies conducted by a group of investigators from the Department of Pediatrics at Case Western Reserve University (Hales et al., 1976; Kennell et al., 1974; Klaus et al., 1970, 1972; Ringler et al., 1975). The work constitutes educational research only in the broadest sense of that term, but is instructive nevertheless. Taking as their point of departure observations on animals revealing complex, species-specific patterns of mother-neonate interaction immediately after delivery (Rheingold, 1963), the investigators undertook to explore this phenomenon in the human case. Noting that prevailing hospital practices resulted in minimal opportunities for contact between mother and newborn, the researchers modified the established procedures to permit mothers to have their naked infants with them for about an hour shortly after delivery and for several hours daily thereafter. To avoid chilling, a heat panel was provided over the mothers' beds. Randomly assigned control groups experienced the usual routine in American hospitals--"a glance at their baby shortly after birth, a short visit six to 12 hours

after birth for identification purposes, and then 20- to 30-minute visits for feeding every four hours during the day" (Kennell et al., 1974, p. 173). To insure comparability a heat panel was also installed over the control mothers' beds as well.

The reported results of these experiments strain the credulity of the reader. In the initial investigation (Klaus et al., 1970), all mothers of full-term infants in the extended exposure group exhibited "an orderly progression of behavior."

> The mothers started with fingertip touch on the infants' extremities and proceeded in 4 to 8 minutes to massaging and encompassing palm contact on the trunk.... Mothers of normal premature infants permitted to touch them in the first 3 to 5 days of life followed a similar sequence, but at a much slower rate. (p. 187)

The mothers of full term babies in the experimental treatment also "showed a remarkable increase in the time spent in the 'en face' position in only 4 to 5 minutes" (p. 190).

In a second study (Klaus et al., 1972) with a new sample, 14 "extended-contact" mother-infant pairs, and an equal number of randomly assigned controls, well matched on developmental and family background factors, were compared when their children were one-month old. All of the mothers were primiparous, with healthy, full-term infants. During a hospital examination one month after birth, the mothers in the extended-

contact group significantly more often stood and watched beside the examination table and soothed their babies when they cried. They also showed greater fondling and eye-to-eye contact while feeding their babies, and, in an interview, expressed greater willingness to pick up their infants when they cried and more reluctance and anxiety about leaving the baby in someone else's care.[6] Moreover, these differences were still in evidence when the infants were reexamined at one year of age (Kennell et al., 1974). The mothers in the extended group reported missing the baby more when separated from it; during the physical examination, they were again more likely to stand by the tableside and assist the physician, to soothe the infant when it cried, and to kiss their babies.

In a subsequent follow-up study (Ringler et al., 1975), when the infants were two years old, the mother's conversation with the child was observed and recorded during a free play period in a setting containing toys and books. "Speech patterns of the mothers revealed that those who had been given extra contact with their infants during the neonatal period used significantly more questions, adjectives, words per proposition, and fewer commands and content words than did the control mothers" (p. 141).

Finally, the most recent experiment in the series (Hales et al., 1976) not only provides a much-needed replication of the initial studies in a larger sample (N=60), but does so in a different cultural context and with a more rigorous experimental design that permits pinning down the heretofore unresolved issue of whether there exists a critical period of

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[6] Here is an example of an experiment in which objective observations in the research setting are appropriately complemented by phenomenological data obtained in interview.

susceptibility to extended contact between mother and infant.[7] Although the original investigators spoke of "a special attachment period for an adult woman" that may alter her later maternal behavior (Klaus et al., 1972, p. 463), they acknowledged that their data left open the question of timing: was it a matter of the first few hours after birth, or extended contact over the next several days?[8] In the latest experiment, carried out at Roosevelt Hospital in Guatemala, Hales and her associates have now clarified this issue by introducing two early contact groups, one limited to 45 minutes immediately after delivery, and the second for an equal interval but beginning 12 hours after the infant's birth. The results were uniequivocal. Only the mothers in the immediate contact group were affected:

> Mothers who had contact with their neonates immediately after birth showed significantly more affectionate behavior ("en face," looking at the baby, talking to the baby, fondling, kissing, smiling at the infant) when compared to the mothers in the delayed and control groups.... No significant differences were noted between the delayed and control groups. This study indicates that the maternal sensitive period is less than twelve hours in length,

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[7]This experiment was supported by a grant to the principal investigator from the FCD program on the Ecology of Human Development.

[8]Another, as yet unanswered question is whether the so-called "maternal sensitive period" is indeed restricted to mothers rather than applying to adults generally, including fathers or other males.

> suggests the importance of skin-to-skin contact and compels reconsideration of hospital practices that even briefly separate mother and infant. (Hales et al., 1976, p. 1)

Recognizing the functional social system. From an ecological perspective, even more remarkable than the dramatic results reported in this series of experiments are the data they omit. In none of the papers cited is there a single word about the behavior of the infant, and all of the experimental effects are attributed entirely to the mother. Thus the investigators refer repeatedly to "a special attachment period existing in the human mother" (Kennell et al., 1974, p. 173), a "maternal sensitive period" (Klaus et al., 1972, p. 463) and the like. The principle of reciprocity, of course, raises the question of whether the distinctive behavior of the mothers in the experimental group during the initial early contact, subsequent extended exposure, and later follow-up might not have occurred, at least in part, as a response to a sequence of activities initiated by the developing infant, and reciprocated by the mother in a progressively evolving pattern of social interaction. Regrettably, the possibility remains unexplored. In keeping with the classical experimental model, the focus of scientific attention in these studies was limited to the subjects of the research, who, in this instance, were not the children but the mothers. The omission is all the more striking given the fact that the infants were not only always present in the research situation, but all of the mother's behavior being observed was directed toward them.

Taken as a whole, this series of experiments on the effects of early, extended mother-infant contact provides excellent examples of several defining properties of an ecological research model, both by demonstration and default. On the one hand, the work constitutes a clear instance of ecologically valid experimentation focused directly on developmental processes. Moreover, it presents an example par excellence of how experimental intervention can bring to light critical features of an ecological process hardly likely to be identified through straightforward naturalistic observation in the unaltered existing setting. But, on the other hand, the research presents a striking example of failure to take into account the total social system actually functioning in the given situation.

This dramatic lacuna in an otherwise impressive series of studies gives rise to our next proposition.

> Proposition 7. An ecological experiment requires recognition of the social system actually operative in the research setting. This system will typically involve all the participants, not excluding the experimenter. This is the requirement of recognizing the totality of the functional social system in the setting.

Beyond the dyad. The Western Reserve experiments reflect the influence of the traditional laboratory paradigm in still one other respect; they are limited to a two-person model. As we have already noted, the classical psychological experiment allows for only two participants: E and S. In most real-life settings, there are usually more than two

people acting in more than two roles. Thus, in the home there is usually also a father and, often, other siblings and adults; in the day care center, preschool, or school, there are other children, as well as care-taking adults. Even in those researches that take into account the activities of more than two persons in differing roles, the behavior of each is usually analyzed separately and interpreted as an independent effect. As a case in point, we may consider recent work on father-infant interaction.[9] Much of this research treats the behavior of the father, and any reaction it may evoke in the child, exclusively in class-theoretical terms as attributable entirely to the father without regard to the possibility that both the father's action and the child's responses may be influenced by the mother--her presence or absence, and the possible effect of her behavior on the interaction of the father with the child. Analogous considerations of course apply to research on mother-child relations. In more general terms, the actual system operating in a given setting often extends beyond a simple dyad to triads, tetrads, etc., and this fact must be taken into account. To state the issue in propositional form:

> Proposition 8. In contrast to the conventional dyadic research model, which is limited to assessing the direct effect of two agents on each other, the design of an ecological experiment must take into account the existence in the setting of systems that include three or more elements and hence permit the indirect

[9] For a comprehensive review of this literature, see Lamb (1975a, 1976a).

> influence of any one of these on the direct relations taking place between the others, operating as a subsystem. This is the requirement of analyzing social interactions and second-order effects in the N+2 systems, where they are in fact present.

To examine this principle in practice, we may turn to a series of investigations by Lamb (1976b, 1976c, 1976d), one of the few researchers on parent-child interaction who has employed a true three-person model in the analysis of his data.[10] First analyzing his data in conventional fashion, Lamb discovered that infants directed more affiliative behavior and exhibited greater preference for fathers than for mothers. He then went on to assess levels of interaction as a function of the presence or absence of a second parent in the setting; in other words, he contrasted behavior in a two-person vs. a three-person system. In general, not only the infant but the parent as well tended to interact more when only one parent was present, regardless of whether this was the mother or the father.

Actually there were four people interacting in Lamb's research setting, the fourth being a home visitor. In fact, the possibility arises that the salience of father-infant interaction in Lamb's home observations may have been enhanced as a function of the fact that the visitor was a woman. It was the visitor's task "to interact with the parents and the

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[10] Lamb's research has been supported by a grant from the FCD program on the Ecology of Human Development.

child in the same manner as would any visitor to the home" (Lamb, 1976b). No data are reported on the extent to which the "guest" became engaged with one parent more than the other. But given the fact that the visitor was of the same sex as the mother and that concern for young children is more closely associated with the female role, it would not be surprising if the wife's involvement in the conversation was greater than the husband's. Under these circumstances, the latter would be freer to engage in interaction with the child. Thus, Lamb's study may in fact have involved not a three- but a four-person system, in which the sex of the fourth participant, the visitor, could have served as the source of what would properly be referred to in our terminology as a third-order effect--an indirect influence operating in the first instance on the mother, whose restricted availability, in turn, enhances the interaction between father and child. The existence of such an effect could be demonstrated experimentally by systematically varying the sex of the visitor and observing any resultant change in patterns of interaction in the four-person system.

The presence of N+3 systems and associated higher effects is not likely to be recognized unless such possibilities are systematically considered in the research setting. The need for such consideration dictates the following proposition:

> Proposition 9. The design and analysis of an ecological experiment in a setting involving more than three persons (i.e., an N+3 system) must take into account all possible subordinate systems (i.e., dyads,

triads, etc.) and the potential higher-order effects associated with them. This is the requirement of comprehensive analysis of possible subsystems and higher-order effects within settings.

Surely by now the question has arisen in the reader's mind whether such complex phenomena are worth investigating. Have we not come to the point of diminishing returns in examining details of negligible significance for learning and development? Paradoxically, from the perspective of an ecological theory, the argument runs the other way. Specifically, as one moves from a dyad to an N+2 system, the resulting structure offers possibilities for greater stability and power through mutual assistance, complementarity, spelling each other off, and reinforcement, provided both directly and indirectly through third parties. The optimal size of systems for various types of educational tasks, and, more importantly, the optimal structure of such systems remain empirical questions, but surely worthy of investigation. Some evidence that N+2 systems, particularly as they cut across settings, do have untapped potential for enhancing educative and developmental processes appear in studies to be cited in support of subsequent propositions. But before turning to these we must take note of yet another source of higher order effects.

The indirect impact of physical and temporal factors. Environmental influences in educative processes are of course not limited to human beings. However, in keeping with the classic two-element research model, these influences are usually thought of as acting directly on the learner.

As a result, we have tended to overlook the possible operation of higher order effects operating indirectly. We offer two examples.

The impact of prolonged exposure to apartment noise. A case in point is provided by an elegant ecological study of the influence of apartment noise on auditory discrimination and reading ability in children (Cohen, Glass, & Singer, 1973). In summarizing the design and the data, we cannot improve upon the authors' abstract:

> This study examined the relationship between a child's auditory and verbal skills and the noisiness of his home. Expressway traffic was the principal source of noise. Initial decibel measurements in a high-rise housing development permitted use of floor level as an index of noise intensity in the apartments. Children living on the lower floors of 32-story buildings showed greater impairment of auditory discrimination and reading achievement than children living in higher-floor apartments. Auditory discrimination appeared to mediate an association between noise and reading deficits, and length of residence in the building affected the magnitude of the correlation between noise and auditory discrimination. Additional analyses ruled out explanations of the auditory discrimination effects in terms of social class variables and physiological damage. Partialling out social class did, however,

> somewhat reduce the magnitude of the relationship between noise and reading deficits. Results were interpreted as documenting the existence of long-term behavioral after-effects in spite of noise adaptation. (p. 407)

The investigators viewed their research as a real-life counterpart to laboratory experiments demonstrating degradation of task performance as a direct after-effect of exposure to noise, and interpret the results of the present field study in the same terms. The two situations are not precisely analogous, however, since the real-life setting included other persons besides the children who were selected as the subjects of the study. Moreover, these other persons, who were the child's parents and other members of the family, were also exposed to traffic noise and, in all likelihood, affected by it. If so, the possibility remains that the impairment of the child's auditory discrimination and verbal skills might have come about not only as a function of his own difficulties in hearing, sustaining attention, etc. in a noisy environment, but also because others around him, notably his parents, were similarly affected, engaged him less frequently in conversations, reading aloud, or correction of the child's verbal utterances. No data are available to demonstrate or disconfirm the existence of such a second-order effect, but relevant information could have readily been obtained had the other participants in the setting been included in the research design and interviewed about the nature and frequency of activities involving verbal interaction with the child or in his presence.

Indirect effects of television. Most of the research in this area has been concerned with the direct effects of the programs viewed by the child on his knowledge, attitudes, and behavior; the indirect influences on the child through the modification of patterns of family life have scarcely been mentioned, let alone investigated. As this author has written elsewhere (Bronfenbrenner, 1973c):

> Like the sorcerer of old, the television set casts its magic spell, freezing speech and action and turning the living into silent statues so long as the enchantment lasts. The primary danger of the television screen lies not so much in the behavior it produces as the behavior it prevents--the talks, the games, the family festivities and arguments through which much of the child's learning takes place and his character is formed. (p. 170)

In a review of research literature bearing on this issue, Garbarino (1975) was able to identify only one investigation that dealt with the question explicitly and systematically. In a field survey Maccoby (1951) found that 78% of the respondents indicated no conversation occurring during viewing, except at specified times such as commercials, and 60% reported that no activity was engaged in while watching. On the basis of her findings, Maccoby concluded:

> The television atmosphere in most households is one of quiet absorption on the part of family members who are present. The nature of the family

> social life during a program could be described as "parallel" rather than interactive, and the set does seem quite clearly to dominate family life when it is on. (1951, p. 428)

It is noteworthy that Maccoby's study was published a quarter of a century ago and no further research has been done on the problem since that time. With the rapid growth of television, and the television culture, in the intervening years, the impact of the medium on family life has, in all probability, become both more pervasive and profound. The question of how any resultant change in family patterns has, in turn, affected the behavior and development of children (i.e., the second-order effect) remains completely unexplored.

These and related studies lead to the following proposition:

> Proposition 10. Among the elements of the setting that can instigate second-order effects are time factors and features of the physical surroundings. Ecological experiments must therefore take into account temporal and spatial arrangements, including the objects contained in the space,[11] as possible indirect influences on social interaction in the setting.

[11] Although the rapid growth in recent years in environmental psychology (e.g., Proshansky et al., 1970; Moos, 1976) has led to a proliferation of studies on the impact of physical factors on behavior, little of this research has focused on learning processes and even less on the indirect effects of the physical environment through its impact on those who deal with the learner rather than on the learner himself.

The analysis of the setting in systems terms. We have now concluded our analyses of systems properties in the immediate setting containing the learner. As a result, we are in a position to formulate a final comprehensive proposition regarding the conceptual model that underlies an ecological experiment.

> Proposition 11. Whereas in a conventional research model antecedent and consequent conditions are conceptualized in terms of separate variables that are treated as distinct from one another, linear, and additive, in ecological experiments both antecedents and consequences can be conceived as variations in the structure or state of the setting as a system; that is, the organization of the elements of place, time, roles, and activities that define a setting at a particular point in its development. This general requirement for the ecological research model is referred to as the conceptualization and analysis of the setting in systems-terms.

Examples of the application of this principle in concrete research design appear in both preceding and succeeding pages. To recapitulate, the Western Reserve experiments document change in the mother-infant system as a function of extended contact between the members of the dyad within the first hour after birth. Unfortunately, as we have already noted, the investigations have thus far provided only a one-sided uni-

directional view of what is in fact a dual, reciprocal structure. A fuller perspective is provided in Lamb's researches on the parent-child system as it is altered from a dyadic to a triadic structure that permits second-order effects. An ecological experiment yet to be conducted would examine changes in the parent-child system in the home, or--to shift to another setting--the teacher-pupil system in the school as a function of the introduction of television into the setting.

All of the foregoing examples, however, and the propositions they illustrate, deal with a restricted segment of the environment. In our topological schema of the ecological field, they remain at the level of the micro-system, the immediate situation containing the child, and even there, they deal with only one setting at a time. We consider next the implications for our research model of treating two or more settings simultaneously.

IV. The Meso-system: Relations Between Settings

While learners have been studied in a variety of environments, there are few investigations in which the behavior and development of the same learners has been examined as a function of their exposure to different settings.[12] Thus we usually carry out our researches either in the laboratory, or the home, or the classroom, but seldom in more than one context simultaneously. From a theoretical viewpoint, we may note here a continuity of the traditional research paradigm, now across domains; the restrictive two-person system at the level of the individual becomes an

[12]The work of Barker, Schoggen, Wright, and their colleagues (Barker & Gump, 1964; Barker & Schoggen, 1973; Barker & Wright, 1954) represents a notable exception, although in their research, settings are conceived and analyzed almost exclusively in behavioral terms with only incidental reference to their social-structural properties.

analogous person-in-single-context model at the level of settings. Once a second setting is introduced, the system becomes triadic and, accordingly, allows for the possibility of second-order effects, now at the level of settings. Such theoretical enrichment generates an array of new and provocative research questions. Not only does it necessarily introduce a comparative perspective, but it also calls attention to the importance of investigating joint effects and interactions between settings (for example, home and school, family and children's peer group, the peer group and the school, etc.), and thereby highlights the possibility that events in one milieu may influence the child's behavior and development in another. Thus the experience of a child in day care, in the classroom, or the informal peer group, may change his pattern of activities and interaction with parents or siblings in the home, or vice versa, with consequent implications for learning and development.

In order to examine the joint effects of exposure to more than one setting, an ecological research model must have certain additional properties which we present in the next series of propositions. We begin with a general principle that outlines the range of phenomena that the research model must encompass.

> Proposition 12. In the traditional research model, behavior and development are investigated in one setting at a time without regard to possible interdependencies between settings. An ecological approach invites consideration of the joint impact of two or more settings or their elements. This is the requirement, where more than one setting occurs, of analyzing interactions between settings.

Subsystems Across Settings

We take as our initial examples, the earliest shifts in setting that a human being typically experiences in modern societies, first the temporary separation of the newborn from the mother to the hospital nursery, and then the move from the hospital to full-time maternal care in the home. An important study by Scarr-Salapatek and Williams (1973) examined the effects of an experimental intervention in the experience of babies born prematurely to mothers from severely deprived socioeconomic backgrounds. The authors describe the rationale for the experiment in the following terms:

> Infants who are born at low birth weights to impoverished mothers are at least doubly disadvantaged. Their biological vulnerability and their subsequently poor social circumstances have been shown to interact with particularly disastrous effects upon later intellectual functioning....
>
> A program of nursery and home stimulation was planned to demonstrate the advantage of early intervention on low-birth-weight, socially disadvantaged infants.... Scientific goals were also served in that the effects of varied stimulation in high-risk infants could be evaluated. (pp. 94-95)

The subjects of the experiment were 30 infants under 1800 grams born to Black mothers "from the lowest SES group in Philadelphia...who could afford no other kind of care and who did not seek care early enough in pregnancy to enroll...at other hospitals." An indication of the nature

of the family setting and the broader ecological context in which the family lived is provided by the following description of the difficulties experienced by the investigators in conducting the second, follow-up phase of the study in the children's homes:

> Maintaining contact with the mothers for over a year was difficult. Many moved every few weeks or months without forwarding addresses.... The living conditions of...the infants varied--some lived alone with their mothers and other relatives, some with relatives alone, and some in foster homes for all or part of the year. Many infants changed their living circumstances during the year as mothers got married, moved back with their mothers, left their mothers, and so forth.... The mothers were typically young; only half had ever attended a prenatal clinic. (pp. 95-96)

Infants were assigned consecutively to the experimental or control group as they entered the premature nursery. In the first phase of the study, conducted in the hospital, the babies in the control group "received standard pediatric care for low-birth-weight infants. They were maintained in the isolettes and fed and changed with minimum disturbance" (p. 97). For infants in the experimental group,

> The nursery staff...were instructed before the study began to provide special visual, tactile, and

> kinesthetic stimulation that approximated good home conditions for normal newborns. Since standard newborn care for premature infants consists of near-isolation from patterned stimulation while in isolettes, our goal was to introduce handling, human faces and voices, and patterned visual stimulation...
>
> As soon as the E infants could maintain their body temperatures for about 30 minutes (usually within 1 week after birth) they were removed from the isolettes for feeding and "play" times. The practical nurses rocked, talked to, fondled, and patted the infants during feedings in which they were held in the nursing position and could regard the nurses' faces. (p. 97)

Once babies in either group were judged mature enough, they were moved from the isolettes to open bassinettes. The control infants were handled only for feeding, changing, and examinations, whereas the experimental group continued to receive special stimulation, both visual and social. Large mobiles were hung over the cribs, and "the nurses were instructed to talk to the E infants, pick them up as frequently as possible when awake, and to rock and play with them around feedings" (p. 98).

As soon as the infant was discharged from the hospital, the second phase of the experimental treatment was initiated through a series of weekly visits to the home over a period of two years by a "child guidance social worker," who talked with the mother or other principal caretaker.

> The visits consisted of instruction and demonstration by the social worker of stimulating child care, including observation techniques so that the mother could assess what behavioral "next steps" their infants were ready to take, and games to play which would promote "next steps" in hand-eye coordination, reaching, grasping, vocalizing, sitting up, self-feeding, and the like. (p. 98)

No home visitors were available to mothers in the control group, although, before leaving the hospital, they were provided with information on the problems and care of low-birth-weight infants and told about a "high risk clinic" that provided pediatric care through the first few years of life.

Before turning to a consideration of results, we call attention to a feature of the experimental treatment that has special significance in terms of an ecological model for human development; namely, the mothers were not involved in the special program until after their children were discharged from the hospital. To be sure, this was not the investigators' original intention:

> We had hoped to include the...mothers in the stimulation process, but this proved impractical because most were unable or unwilling to come frequently to the hopsital and play with their babies. In a more advantaged group of low-birth-

> weight infants, the inclusion of mothers would have been practicable and important for developing a relationship between the infant and his mother in the first 2 months of life. (p. 98)

Although initial measures of maternal health and neonate developmental status had favored the control group, after the stimulation program at the hospital had been in effect for four to six weeks, the experimental infants showed significantly greater weight gains and "slight to significant advantages" on the Brazelton scales. By one year, "an average difference of nearly 10 IQ points" separated the two groups. The mean score for the infants in the experimental treatment was 95 thus bringing them "to nearly normal levels of development" (p. 99), truly a remarkable achievement for a low-birth-weight sample from so deprived a socioeconomic background.

Although this important experiment does document the joint effects of experience in two different settings, hospital and home, the design does not permit a definitive assessment of the independent contributions of each, since there were no comparison groups receiving the home or hospital treatment only. Nevertheless, the research illuminates, both by demonstration and default, some of the parameters required of an ecological model appropriate for analyzing developmental processes for the same children in more than one setting. To begin with, we observe that the existence of two locales (i.e., hospital and home) necessarily involves an N+2 system that extends across both settings instead of being limited to one. Thus, in the case at hand, there are participants

in four different roles with the infant appearing in both settings; the nurse only at the hospital; and mother and social worker primarily in the home. This four-person structure permits a variety of possible subsystems and higher-order effects, both within and across settings. Unfortunately, in keeping with the traditional research model, the measures obtained focused almost exclusively on the experimental subjects--i.e., the infants--and were confined to test scores in the bargain. Thus no systematic data were collected about the infants' immediate response to the stimulation as it was provided, nor about the participants' interactions with and perceptions of each other. Here and there throughout the report, however, there are tantalizing fragments of information suggesting that certain patterns of response and relationship were central to the developmental processes that were taking place. For example:

> Newborn prematures were observed to look at birds suspended over their isolettes. Previously skeptical nurses (and investigators) were amazed to see 3-pound infants gazing at the brightly colored, patterned birds...
>
> The infants were observed to gaze at the faces of the nurses who fed them and to respond socially to handling and voices by quieting when distressed....
>
> Most mothers...were interested in the social worker's help, not only for their children but for themselves. They sought her advice and aid on many

> practical details of life. . .and in personal problems (e.g., troubles with men, mothers, siblings; feelings of depression). (pp. 99-100)

The mothers in the experimental treatment were also very cooperative. Despite frequent moves, only one child was lost to the research from this group, compared to six from the control sample. Even though several of the experimental children were cared for by foster mothers for part of the year, the mothers assisted the social worker in arranging for continuation of the home visits with the new caretaker. "In no case was the home visitor excluded from an infant's home" (p. 98). Such continuity and cooperation are hardly typical in research with families from "the lowest SES group," and testify to a strong involvement by the mothers in their premature infants and in the program of home visits designed to foster their children's development.

Taken together, the foregoing bits of information suggest that, within the four-person system produced by the experimental treatment, certain subsystems became especially strong; namely, nurse-infant; social worker-mother; mother-infant; and, perhaps, mother-infant-social worker, the last involving the second-order effect of the home visitor on the interaction of the mother with her child. Another second-order effect, in this case across both time and space, appears highly likely for the influence on the mother-infant dyad of the infants' involvement in the clearly reciprocal relationship developed earlier with the nurses at the hospital, a pattern reminiscent of the attachment between the newborn

and the mother described in the Western Reserve experiments summarized above (pp. 32ff).

In fact, one wonders what could have happened had the mothers in the experimental group been provided with opportunities for "extended contact" of the type afforded to mothers of prematures in the previously cited study by Klaus et al. (1970). Perhaps, following this experience, the mothers would not have been so "unable and unwilling" to come to the hospital. Or, failing that, suppose the researchers had made use of the apparently unexploited subsystem of nurse-social worker-mother by having the social worker begin her visits as soon as the mother returned home after delivery, and report to her the nurses's enthusiastic descriptions of her premature baby's surprisingly "mature" responses to stimulation of the kind normally provided to full-term infants at home?

We mention these possibilities primarily not for their relevance to the experiment under discussion (which constitutes a substantial scientific contribution in its present form) but as a concrete illustration of our next general proposition; which represents an extension of Proposition 9 beyond a single setting.

> Proposition 13. The design of an ecological experiment involving the same person in more than one setting should take into account the possible subsystems, and associated higher-order effects, that could exist across settings.

The preceding proposition illuminates the shortcomings of existing research bearing on the next transition commonly experienced by young children in Western society: that from the home to the day care center or preschool. The work in this area has been recently reviewed by Bronfenbrenner (1976). Virtually all of the investigations have employed the same strategy: comparing the performance and behavior of children subjected to group care for varying lengths of time, ranging from none at all to several years. A number of the studies were flawed by serious methodological defects (e.g., failure to employ blind observers or to control for family background characteristics, or parental motivation, such as willingness to enroll the child in day care).

Relying on the results of the better-designed researches, Bronfenbrenner found no evidence of differences in cognitive development as a function of exposure to day care. There were significant effects, however, in the socioemotional sphere. Young children with prior experience in group care showed a better adjustment upon entering a new day care setting than age-mates brought up only at home, but the latter appeared to adapt to the new surroundings within a matter of hours (Schwarz et al., 1974, 1973, 1971). Longer range consequences were observed, however, as children prolonged their stay in the day care environment. In general, the results indicated that children in group care (as distinguished to home or family day care) tended to be more aggressive both with peers and adults, less cooperative, and more prone to interact with age-mates than grown-ups, and to engage in physical rather than emotional or cognitive activities.

Since length of exposure to group care is likely to be inversely correlated with age at entry, the question arises to what extent the foregoing differences are a function of how old the child was when he was first placed in the center. A recent study by Largman (1976),[13] examines this question systematically. The results indicate that, compared to children enrolled at older ages, infants placed in group day care at two years of age or younger, when observed as two-year-olds, "were more defiant, cried more. . .had more temper tantrums. . .were more angry and had more difficulty in relating to peers" (p. 1). Among older children, there was a curvilinear relationship, with children placed in day care between two and three years of age showing a better adjustment than those who entered between three and four.

Largman interprets these results principally from a psychoanalytic perspective in terms of the changing characteristics of the child's dependency relationship with the mother. This interpretation is consistent with the unidirectional model employed not only by Largman but other researchers as well who have compared behavior and development in home vs. day care settings;[14] that is, experience in the family is presumed to affect the child's behavior in the center, but not the reverse. Thus no study has at yet examined the possible impact of day care on patterns of interaction within the home.

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[13]Largman's research was supported by a grant from the FCD program on the Ecology of Human Development.

[14]As previously noted, the research of Cochran (1975, 1976) represents an important exception in this regard.

Reciprocity Between Settings

Although no data are presently available documenting the effects on the child of reciprocal influences between the family and the day care center, there is evidence on the impact of a two-way process taking place between home and school. The phenomenon of reciprocity between settings was first "brought home" in almost literal fashion to the present investigator a decade ago in connection with an ongoing program of cross-cultural research on patterns of child rearing. In each of our comparative studies from the first conducted in West Germany (Devereux et al., 1962), to the most recent in Israel (Devereux et al., 1974), we observed the same seemingly unlikely phenomenon. Our data on child rearing practices were obtained from reports by sixth-graders in their school classrooms, and, within every culture including the United States, we found significant differences in parental behavior from one classroom to the next.

The probable origins of this phenomenon have been traced in a doctoral dissertation by Siman (1973) on the interaction between family and peer group in the socialization process. In a study of 41 naturally-occurring adolescent friendship groups in New York City, Siman found that the teenagers' descriptions and evaluations of the behavior of their parents varied systematically with characteristics and activities of the peer group, drawn primarily from among the young person's classmates in school. Conversely, in two companion researches, Condry and Siman (1974, 1976) report that the involvement of children in informal peer groups was less a function of positive attraction than of perceived inattention and indifference in the home; peer-oriented youngsters described their parents as being less affectionate and less

firm in discipline. Taken together, their findings reveal a reciprocal relation between family and peer group settings. Since such reciprocity between settings is likely to be a general ecological phenomenon, we take note of it in the next proposition:

> Proposition 14. The design of an experiment involving more than one setting must take into account the possibility of reciprocal interactions between settings as systems.

Replication at the Level of Settings

The finding of significant differences from one classroom or peer group to the next has important methodological as well as substantive implications. Specifically, disregarding the possibility of such variation seriously increases the risk of a Type I error--that is, claiming a difference when one does not in fact exist. The nature of this pitfall is best revealed by an extreme, but probably not wholly hypothetical, example. Let us suppose that in a particular cross-cultural study, say, of cooperative behaviors among ten-year-olds, all of the children in each society were selected from one classroom. Under these circumstances, any significant differences between the two groups might reflect variation not between cultures but simply between the classrooms (as a function of teacher, group climate, etc.). To determine whether two societies actually differed in children's cooperative behavior, it would be necessary to demonstrate that cultural differences overrode the variation among classrooms within cultures (with the classrooms also drawn from different schools as well).

In statistical terms, the error term employed for testing the main effect for culture would have to be based not on variance among individuals but among classrooms. This requirement can be accomplished by conforming to the condition set forth in the following proposition.

> Proposition 15. If the results of an ecological experiment are to be generalized to other settings of the same type, several examples of each type of setting must be included in the research design. This is the requirement of replication at the level of settings.

Adherence to this requirement can have sobering consequences. For example, Olds (1976)[15] in a comprehensive experiment on cross-age tutoring, provided in his design for replication at the level of schools. Under these circumstances, he found no reliable evidence for the widely publicized claim (Gartner, Kohler, & Riessman, 1971) that older children teaching younger children themselves gain in learning skills. Olds' results, and his thorough analysis of earlier work, strongly suggest that the reported success was a function of rather specific situations and circumstances related to a high frequency and length of tutoring sessions, the teaching resources made available to the tutors by the school, and, most critically, a close match between the learning needs of the tutor and the skills that he is teaching the younger child.

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[15]Olds' research was supported by a grant from the FCD program on the Ecology of Human Development.

Substantive gains from replication of settings. The methodological costs and disappointments of replication can occasionally bring substantive benefits. Especially in contrived experiments, treatment by setting interactions can alert the investigator to the ecological conditions that influence the effectiveness of the experimental manipulation. Another instructive illustration is provided in an experiment by Almeida (1976).[16]

Working in poor residential areas in Mexico City, the investigator offered an eight-week training course in child development, in one case for teachers alone, in another for teachers and parents together. In each region, one sixth-grade classroom was assigned to the experimental treatment (parents plus teacher) and another to the control group (teachers only). The weekly two-hour training sessions were conducted by persons who live and work in the immediate neighborhood. The general hypothesis of the study is that parental participation will result in enhanced motivation and learning on the part of pupils as a function of increased mutual understanding and convergent value commitments on the part of parents, teachers, and children.

Almeida's findings are instructive both substantively and methodologically. The difference between the experimental and control group turned out to be significant on most outcome measures when tested against individuals within treatments, as is typically done in psychological experiments. But none of the treatment effects were significant when tested against an appropriate error term based on differences between experimental and control classrooms within neighborhoods. This came about because the treatment was effective in some neighborhoods but not in others.

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[16] Almeida's research was supported by a grant from the FCD program on the Ecology of Human Development.

Pursuing this matter further, Almeida found reliable correlations between the child's gain score over the eight-week period and various measures of social class (in particular, parents' educational level and the presence in the home of such items as newspapers and encyclopedias). But the relationships were significantly stronger at the level of classrooms than of individuals. Specifically, a child's gain score was better predicted not by the socioeconomic status of his own family but by the average social class level of the children in his classroom. In other words, what counted most was not his own background but the background of his classmates. Since, in Almeida's research, the classrooms are in different schools, they also reflected neighborhood differences. In checking on these differences, Almeida discovered that the schools exhibiting greatest gains were located in neighborhoods with well-developed social networks, such that families were in some communication with each other. Moreover, under these circumstances, not only the experimental classrooms, but those in the control group showed improvement, presumably as a function of horizontal diffusion.

Replication of settings as a methodological issue. Almeida's ability to generalize his findings was severely limited by the small number of schools and neighborhoods included in his sample. Indeed, replication on a sufficient scale to permit reliable generalization is usually beyond the means of an individual investigator. The inclusion of more than one setting in the research design is nevertheless desirable, again for heuristic purposes. As in Almeida's research, such replication can not

only alert the investigator to unwarranted conclusions but, more importantly, can illuminate relationships existing both within and between settings that may profoundly influence the educative process.

The foregoing line of argument should not be interpreted to imply that experiments limited to a single setting are not worth doing. On the contrary, given our heuristic aims, this is probably the most efficient way to proceed, both from the point of view of science and of economics. There is no advantage in replicating a mistake that can be recognized from a single trial. But in carrying out such ecologically delimited experiments, it is necessary to heed two methodological precautions sufficiently important to warrant statement in a corollary.

Corollary 15a. When replication of settings is minimal or completely precluded because of limited resources:

1) The selection of the specific example(s) within a setting category (e.g., classrooms, schools, neighborhoods) should involve careful consideration of the range of possible choices in order to maximize what can be learned from the particular cases chosen.
2) In the interpretation of findings, it should be explicitly acknowledged that the observed results may be specific to features of the particular examples employed, and hence are not generalizable to other settings of the

> same kind until the findings are cross validated in another sample. For the same reason, a deliberate effort should be made to identify specific characteristics of the examples employed and take them into account in the interpretation of results.

In the absence of such precautions, there is the danger, in studies lacking replication at the level of settings, of treating as a main effect a finding that is actually a higher order interaction specific to the particular examples of the setting included in the sample.

V. The Exo-system: Learning Settings in Context

Almeida's finding that the effectiveness of parent-involvement was a function of social networks interconnecting families within the community takes us beyond the immediate settings containing the learner to the level of structures encompassing or impinging upon these immediate settings. Such exo-systems are both formal and informal: examples include the nature and requirements of the parents' work, characteristics of the neighborhood, health and welfare services, government agencies, the relations between school and community, informal social networks, transportation systems, law enforcement practices, shopping facilities, means of communication, patterns of recreation and social life, and a host of other ecological circumstances and events that determine with whom and how the learners spend their time; for example, the fragmentation of the extended family, the separation of residential and business areas, the breakdown of social networks, the disappearance of neighborhoods,

zoning ordinances, geographic and social mobility, growth of single-parent families, the abolition of the apprentice system, consolidated schools, commuting, the working mother, the delegation of child care to specialists and others outside the home, urban renewal, or the existence and character of an explicit national policy on children and families. In sum, here in the third circle of our ecological model are whole subcontinents waiting for scientific exploration--waiting because, to date, there have been very few investigations of exo-system effects on learning processes.

One might challenge this assertion on the grounds that studies of social class differences provide a massive body of information about the impact of the larger environment on learning. Such studies are certainly relevant, but they fail to meet a basic requirement of our ecological model; namely, in educational research, social class is usually treated as a variable rather than in systems-terms as stipulated by Proposition 11.

In fact, the properties of the research model for investigating relations at the level of the exo-system are precisely those that have been specified in our prior propositions; the only difference is that these stipulations are now applied to settings and systems beyond the immediate situation containing the learner and have impact on that immediate situation. In other words, exo-systems represent sources of higher-order effects from more remote regions of the environment.

From this point of view, exo-systems do not generate any new functional principles; their place and purpose in our theoretical schema is

essentially heuristic: to alert researchers to aspects of the larger environment that may be critical for the process of making human beings human. It is this heuristic function that is embodied in our next proposition.

> Proposition 16. Research on the ecology of education requires experiments that go beyond the immediate setting containing the learner to the examination of larger contexts, both formal and informal, that affect events within the immediate setting.

As already indicated, examples that meet the foregoing criteria are difficult to find. We have been able to discover only a few correlational findings and fragmentary facts, and offer three instances:

In a study of child neglect among low income families, Giovannoni and Billingsley (1970) sought to identify the environmental conditions associated with the parents' treatment of the child. In addition to such factors as number of children, single parenthood, inadequate housing and sleeping arrangements, absence of a telephone or wrist watch, or other correlates or consequences of extreme and prolonged poverty status, differentiating factors included the existence of a functional kinship network, as well as church attendance. In summing up their findings, the authors concluded as follows:

> Among low-income people, neglect would seem to be a social problem that is as much a manifestation of social and community conditions as it is of any individual parent's pathology. (p. 204)

Corroborative data on a broader scale come from a correlational analysis of child abuse reports and socioeconomic and demographic information for the 58 counties of New York State (Garbarino, 1976). In the investigator's words, "A substantial proportion of the variance in rates of child abuse/maltreatment among New York State counties (three samples) was found to be associated with the degree to which mothers do not possess adequate support systems for parenting and are subjected to economic stress" (p. 185).

The fragmentary fact appears in the previously cited experiment of Scarr-Salapatek and Williams (1973) on the effects of early stimulation on premature infants. What were the long range effects of their highly successful intervention? The sobering answer to this query appears in the following statement at the conclusion of their report:

> A longer-term follow-up of infant development in the E group would be very desirable to see if initial gains were maintained through the second year. Unfortunately, the shortage of federal funds has closed the High Risk Clinic so that pediatric care and psychometric evaluation are no longer available to the low-birth-weight group. (p. 100)

This sobering statement escalates us to the highest level of our ecological model, the macro-system of institutions and associated ideologies that permeate the society as a whole. But before entering this more rarefied atmosphere, we must take cognizance of yet another parameter of the ecological field that has been present in many of the researches we have examined but has escaped our notice because it is, in a sense,

orthogonal to the more obvious dimensions of space and social structure. We refer to developmental changes in the learner's life span.

Developmental Transitions as Ecological Experiments

A number of such changes have served as the focus of investigation in the researches we have already examined. To recall but a few: a mother is presented with her newborn infant for the first time (Klaus et al.), the baby returns home from the hospital (Scarr-Salapatek & Williams), the child is enrolled in a day care center (Schwarz et al.), or promoted to the next grade in school (Seaver). It is not difficult to think of other situations along the same line: the arrival of a sibling; the move from preschool to school; getting a new teacher; going to camp; graduations; "dropping out"; finding one's first job; changing jobs; losing a job; marriage; becoming pregnant; having relatives or friends move in (and out again); buying one's first family TV set, car, or home; vacations; travel; moving; divorce; remarriage; changing careers; emigrating; or to return to the more universal--becoming sick; going to the hospital; getting well again; returning to work; and--the final experience to which there are no exceptions--death.

Systems-properties of developmental transitions. We call attention to this varied array of events in everyday life not for their personal but their scientific significance. For each one constitutes, in effect, a ready-made experiment of nature with a built-in, before-after design in which each subject serves as his own control. Moroever, these developmental transitions are sufficiently diverse to involve every one of the

settings and systems-properties set forth in our sixteen propositions thus far. To begin with, since they all take place in real-life settings, they are ecologically valid by definition. In terms of the elements of the setting, they entail changes over time in role activity, and often place as well (wife to mother, child at home to pupil at school, student to worker, etc.). The magnitude of the micro-system expands and contracts with marriages, births, graduations, divorces, and deaths. Reciprocal processes, second- and higher-order effects are the rule, since a developmental change in the state and status of one member of the system invariably alters the relations between the others. Since almost every transition involves more than one setting, these interactive processes occur not only within but also across setting boundaries, thus involving interactions within higher-order systems. For example, when a child enters day care, the pattern of family activities changes; a divorce can alter the child's behavior in the classroom; dropping out of school has reverberations in the family; and a new job in another town affects home, school, and every other learning environment.

The last example calls attention to the fact that developmental transitions often have their origin not in the immediate learning setting, but in the larger world of those responsible for the learner's education and care. To state the case more broadly in terms of our theoretical framework, what is micro-system for one learner (e.g., the father mastering a new job) becomes exo-system for another (e.g., the child in the classroom).

Finally, developmental transitions provide a structure for conceptualizing the dimension of time in our ecological model. The almost exclusive focus, within both developmental and educational psychology, on the properties of the individual with little reference to context has generated a curiously broken trajectory of theory and research that has a brave beginning, sad ending, and an empty middle. Given a perspective in which development is instigated and paced primarily by events within the organism--that is, by biological change--the outcome is a segmented science that abounds with knowledge about the early years, grows less informative through middle childhood and adolescence, and then becomes virtually silent for decades, until the organism begins to decline, when there is once again a spurt of scientific activity.

Developmental experiments in the ecology of education. To be sure, a number of events in the life cycle discussed above have been the objects of scientific study. But such investigations have seldom been planned and conducted for the explicit purpose of assessing the impact of the experience upon processes of learning. And even when this aim has been pursued, the research design has typically been cross-sectional rather than longitudinal (as, for example, in most studies of home vs. day care). As a result, the inquiry can shed little light on the learning process as a developmental experience. Also, whether cross-sectional or longitudinal, studies to date, as already noted, have focused almost exclusively on one class of persons designated as the experimental subjects. The impact of a developmental transition not merely on the learner but on the enduring systems of which he is a part (e.g., family, peer group, etc.)

remains an unexplored and scientifically promising terrain for ecological research in education.

Nor is the scientific potential of developmental transitions limited to their exploitation as experiments of nature. They may offer even greater promise as contexts for contrived experiments. The researches of Klaus and of Scarr-Salapatek and Williams represent cases in point. Instead of altering the transitions to take the conventional course regarded as normal in our society, these investigators introduced unorthodox innovations. The former violated established hospital practice by allowing mothers to have immediate and extended contact with their newborn infants. The latter, in effect, presumed to treat prematures from severely deprived low income families as if they were full-term offspring from middle class homes. These examples invite equally radical transformation of the subsequent educational transitions that have become regarded as traditional and necessary in our culture. But here once again we are brought to the last level of our ecological structure--the ideological and institutional macro-system. Before entering this new domain, we sum up our analysis of developmental transitions as contexts for ecological research by stating three additional propositions. Unlike their predecessors, which spoke mainly to theory and method, these expand upon scope and substance.

> Proposition 17. A fruitful context for ecological research in education is provided by the developmental transitions that typically occur in the life

of the learner. These transitions include changes in role and setting as a function of the learner's maturation or of events in the life cycle of others responsible for his or her care and education. Such transitions are to be conceived and analyzed as changes in ecological systems rather than solely within individuals.

Proposition 18. Developmental transitions are not limited to the early years but recur, in various forms, throughout the life of the learner. Hence the experimental ecology of education must incorporate a life-span perspective if it is to do justice to the phenomena within its purvey.

Proposition 19. Developmental transitions invite not only naturalistic but also contrived experiments --those that introduce innovations in the established sequence and structure of successive settings and events.

VI. The Macro-system: Experiments on Institutions and Ideologies

To formulate our final proposition, we take cognizance of one more delimiting characteristic of conventional research in education. The foreshortened perspective was first brought to my attention by Professor A. N. Leontiev of the University of Moscow. At the time, a decade ago,

I was an exchange scientist at the Academy of Pedagogical Sciences. We had been discussing differences in the assumptions underlying educational research in the Soviet Union and in the United States. In summing up his views, Professor Leontiev offered the following provocative judgment: "It seems to me that American researchers are constantly seeking to explain how the child came to be what he is; we in the U.S.S.R. are striving to discover not how the child came to be what he is, but how he can become what he not yet is."

The Transforming Experiment

Leontiev's statement is of course reminiscent of Dearborn's injunction ("If you want to understand something, try to change it."), but goes much farther; indeed, in Leontiev's view, it is revolutionary in its implications. Soviet psychologists often speak of what they call the "preobrazuyuschchi eksperiment," the "transforming experiment." By this term they mean an experiment that radically restructures the environment, producing a new configuration that activates previously unrealized behavioral potentialities of the subject. Russian developmental psychologists have indeed been ingenious in devising clever experiments that evoked new patterns of response primarily in the sphere of psychomotor and perceptual development (Cole & Maltzman, 1969). But once Soviet research moves out of the laboratory, the control group disappears, systematic data yield place to anecdotal accounts, and the "transforming experiment" degenerates into a dutiful demonstration of ideologically prescribed processes and outcomes.

For rather different reasons, "transforming experiments" in the real world are equally rare in American educational research. As Leontiev implied, most of our scientific ventures into social reality perpetuate the status quo; to the extent that we include ecological contexts in our research, we select and treat them as sociological givens rather than as evolving social systems susceptible to significant and novel transformation. Thus we study social class differences, ethnic differences, rural-urban differences--or, at the next level down, children from one- vs. two-parent homes, large vs. small families--as if the nature of these structures, and their developmental consequences, were eternally fixed and unalterable, except, perhaps, by violent revolution. We are loath to experiment with new social or educational forms as contexts for realizing human potential. "After all," we say, "you can't change human nature." This precept underlies our national stance on social and educational policy, and much of our educational science as well.

It is obvious that our discussion now is no longer confined to settings and structures on the local scene. We have indeed moved from the mundane structures of a particular community to the level of macro-systems--the institutions, and their associated ideologies --that pervade major segments of the society or the culture as a whole. The implications of this shift for an ecological research model concern the nature of the contrasts to be employed in our experiments. It is one thing to compare the effects on education of systems or system elements already present within the culture; it is quite another to introduce experimental changes that represent a restructuring of established institutional forms and values.

With these unorthodox thoughts, we arrive at the last and most demanding of our propositions defining the nature and scope of ecological experiments in education.

> Proposition 20. Research on the ecology of education requires experiments involving the innovative restructuring of prevailing ecological systems in ways that depart from existing institutional ideologies and structures by redefining goals, roles, and activities, and providing interconnections between systems previously isolated from each other.

The final phrase of Proposition 20 deserves special comment. In the course of two decades of cross-cultural research on child rearing in education the author has been impressed with a distinctive feature of socialization in American society. I first perceived this characteristic in terms of our marked segregation by age (Bronfenbrenner, 1970), but have since seen it in a broader perspective; namely, compared to those in other modern industrialized nations, socialization systems in the United States are more dissociated from each other. In terms of Lewinian theory (1936), they tend to be systems "in abscission," cut off from each other. Thus the home is separated from the school, the peer group from the family, the school from the neighborhood, and all of these settings lack connections with the world of work. Similarly, our research has characteristically been confined to one setting at a time--the home, the classroom, the work place, etc.

This dissociation of social structures has been increasing rapidly in recent decades and has been accomplished by a parallel deterioration of socialization processes and

outcomes (Bronfenbrenner, 1974d, 1975b). Hence experiments that undertake to reverse the process by constructing and strengthening interconnections between ecological systems offer promise both for scientific understanding and for social policy.

For reasons we have already indicated, it is not easy to cite examples of experiments that satisfy the requirements of Proposition 20. There is one classic research, however, that does meet at least some of these exacting specifications. In the early 1950's, Sherif and his colleagues at the University of Oklahoma conducted a study known as the "Robbers Cave Experiment" (Sherif, 1956; Sherif et al., 1961). In the words of Elton B. McNeil:

> War was declared at Robbers Cave, Oklahoma, in the summer of 1954. . . . Of course, if you have seen one war you have seen them all, but this was an interesting war, as wars go, because only the observers knew what the fighting was about. How then, did this war differ from any other war? This one was caused, conducted, and concluded by behavioral scientists. After years of religious, political, and economic wars, this was, perhaps, the first scientific war. It wasn't the kind of war that an adventurer could join just for the thrill of it. To be eligible, ideally, you had to be an eleven-year-old, middle-class, American, Protestant, well-adjusted boy who was willing to go to an experimental camp. (1962, p. 77)

Sherif set out to demonstrate that, within the space of a few weeks, he could bring about two sharply contrasting patterns of behavior in this sample of normal boys. First, he would transform them into hostile, destructive, antisocial gangs; then, within a few days, change them into cooperative, constructive workers and friends concerned about and even ready to make sacrifices for other members of the community.

The success of the effort can be gauged by the following excerpts (Sherif, 1956, pp. 54-58) describing the behavior of the boys after each stage had been reached. After the first "experimental treatment" was introduced,

> Good feeling soon evaporated. The members of each group began to call their rivals "stinkers," "sneaks," and "cheaters." They refused to have anything more to do with individuals in the opposing group. The boys. . . turned against buddies whom they had chosen as "best friends" when they first arrived at the camp. A large proportion of the boys in each group gave negative ratings to all the boys in the other. The rival groups made threatening posters and planned raids, collecting secret hoards of green apples for ammunition. In the Robbers Cave camp, the Eagles, after a defeat in a tournament game, burned a banner left behind by the Rattlers; the next morning the Rattlers seized the Eagles' flag when they arrived on the athletic field. From that time on name-calling, scuffles and raids were the rule of the day. . . . In the dining-hall line they shoved each other aside, and the group that lost the contest for the head of the line shouted "Ladies first!"

at the winner. They threw paper, food and vile names at each other at the tables. An Eagle bumped by a Rat[illegible] was admonished by his fellow Eagles to brush "the dirt" off his clothes.

But after the second experimental treatment,

> The members of the two groups began to feel more friendly to each other. For example, a Rattler whom the Eagles disliked for his sharp tongue and skill in defeating them became a "good egg." The boys stopped shoving in the meal line. They no longer called each other names, and sat together at the table. New friendships developed between individuals in the two groups.
>
> In the end the groups were actively seeking opportunities to mingle, to entertain and "treat" each other. They decided to hold a joint campfire. They took turns presenting skits and songs. Members of both groups requested that they go home together on the same bus, rather than on the separate buses in which they had come. On the way the bus stopped for refreshments. One group still had five dollars which they had won as a prize in a contest. They decided to spend this sum on refreshments. On their own initiative they invited their former rivals to be their guests for malted milks.

How was each of these effects achieved? Treatment One has a familiar ring, at least in American society.

> To produce friction betweer the groups of boys we arranged a tournament of games: baseball, touch football,

> a tug-of-war, a treasure hunt and so on. The tournament started in a spirit of good sportsmanship. But as it progressed good feeling soon evaporated.

The dynamics of the process are best described in the words of a sportswriter acquaintance: "Sherif," he said, "was just applying the Vince Lombardi ethic." He then quoted the classical statement by the coach of the world-champion Green Bay Packers: "Winning isn't everything; it's the only thing!"

But how does one turn hatred into harmony? Before undertaking this task, Sherif wanted to demonstrate that, contrary to the views of some students of human conflict, mere interaction--pleasant social contact between antagonists--would not reduce hostility.

> We brought the hostile Rattlers and Eagles together for social events: going to movies, eating in the same dining room and so on. But far from reducing conflict, these situations only served as opportunities for the rival groups to berate and attack each other.

How was conflict finally dispelled? By a series of strategems, of which the following is an example.

> Water came to our camp in pipes from a tank about a mile away. We arranged to interrupt it and then called the boys together to inform them of the crisis. Both groups promptly volunteered to search

> the water line for trouble. They worked together harmoniously, and before the end of the afternoon they had located and corrected the difficulty.

On another occasion, just when everyone was hungry and the camp truck was about to go to town for food, it developed that the engine wouldn't start, and the boys had to pull together to get the vehicle going.

To move from practice to principle, according to Sherif, the critical element for achieving harmony in human relations is joint activity in behalf of a superordinate goal. "Hostility gives way when groups pull together to achieve overriding goals which are real and compelling for all concerned" (p. 58).

The Robbers Cave Experiment clearly implements the injunction of Proposition 20 for "innovative restructuring of prevailing ecological systems in ways that depart from existing institutional ideologies and structures by redefining goals, roles, activities and providing interconnections between systems previously isolated from each other." But at the same time, this brilliant ecological experiment falls short of penetrating certain critical regions of our environmental model. In the perspective of both time and space, the camp setting was an isolated system--a one-time event with no connections provided to the rest of the child's world. To complete our discussion, therefore, we need some illustrations of ecological experiments that are embedded in the existing social milieu. In the absence of well-designed researches that both meet this criterion and bear directly on human development, we have to resort to the hypothetical examples suggested below:

Proposed Experiment 1: Income maintenance, human development, and education.

Given the consistent association between family income and impairment of the child's development in cognitive, emotional, and social spheres, it would be of great importance to identify the causal connections involved in this relationship. Although a number of experiments on income maintenance have been recently conducted (Watts et al., 1974), these studies have been confined to effects on the family's economic behavior. Such researches could be expanded to encompass any changes in parent-child interaction, activities and opportunities provided to children, and the resulting behavior of the child himself, that are induced as a function of the different income levels provided. Improvements in the child's motivation and learning in school would, of course, be of especial significance in this regard.

Proposed Experiment 2: Facilitating the child's transition into school.

In the light of research findings that effects of preschool intervention programs tend to wash out once the child enters school (Bronfenbrenner, 1974c), an experiment could be undertaken to provide for a more gradual transition by acquainting family members and school personnel with each other in both the school and home settings, and on "neutral ground." An effort would then be made to continue this pattern of joint activity after the child has entered school.

Proposed Experiment 3: Informal networks as support systems for families.

This experiment is based on research findings summarized above (pp. 66-68) pointing to the importance of informal networks for effective family functioning. The experiment would involve making available services of a neighborhood resources specialist whose task would be to

strengthen and, where necessary, provide informal support systems that can assist parents in their child rearing activities, and to create channels of communication and cooperation between the parents and other persons and institutions concerned with the welfare of children and families. A detailed design for such an experiment has been developed by the author in cooperation with colleagues both in the United States and abroad (Bronfenbrenner & Cochran, 1976).

Proposed Experiment 4: Flexible work schedules, human development and education.

A growing problem in contemporary American society is posed by the increasing number of "latch-key children"--i.e., youngsters who come home from school to an empty house (Bronfenbrenner, 1973d; Robinson et al., 1973). Such children are especially prone to academic difficulties, school absenteeism and drop-out, juvenile delinquency, and drug addiction. An experiment designed to illuminate and counteract such effects involves obtaining the cooperation of a business employing a large number of workers to introduce, on an experimental basis, flexible work schedules which would enable parents who wish to do so to be at home when their children return from school. The time would be made up by working other hours. Effects of this policy would be observed in the changing behaviors and attitudes of the parents toward their children and of the children themselves, with particular reference to educational and peer activities.

Proposed Experiment 5: Child care and service to families in the high school curriculum.

To test the hypothesis regarding the disruptive effects of age-segregation in American society, experience in child care and service to families could be introduced on an experimental basis in the high school curriculum. Such an experience could be facilitated by introducing day care centers or preschool programs in the school. Older children would work with the younger ones on a regular basis, both at school and in the younger children's homes, where they would have an opportunity to become acquainted with the youngster's families and their circumstances.

Proposed Experiment 6: Introducing children to the world of work.

This experiment is based on policy and practice presently followed in the U.S.S.R. (Bronfenbrenner, 1970). In that society, units of economic production, such as a shop, office, institute, or other worker's collective, are encouraged to "adopt" as a civic responsibility some group of children like a classroom, hospital ward, or preschool group. The workers visit the children wherever they are, and invite them to visit in return. They take the children on outings, get to know their teachers and their parents--in sum, the adults and children become friends. In the expectation that an American business could be interested in undertaking a similar program, it is proposed to gauge its impact on the children's attitudes and behavior along the lines indicated in preceding

proposals.[17] A control group might consist of children who merely "tour" places of work without establishing friendly associations with the workers themselves.

My purpose in presenting the foregoing proposals is not to advocate their implementation, but, as with the essay as a whole, to generate new, ecological directions of thought and activity in educational research. With this objective, I conclude with an earnest entreaty to love, honor, and perhaps even to obey Dearborn's Dictum, Leontiev's Law, and a new version of Thomas's Thesis: "Experiments created as real are real in their consequences."

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[17] At the author's suggestion a demonstration program of this kind was carried out at the Detroit Free Press by David Goslin, at that time of the Russell Sage Foundation (Goslin, 1971). The program is described in a documentary film entitled "A Place to Meet, A Way to Understand," which is available from the federal government (The National Audio-Visual Center, Washington, D.C. 20409). Unfortunately, it was not possible to attach a research component to the project.

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